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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/521,793	01/21/2005	Elji Tani	264179US0PCT	2037

22850 7590 05/14/2007

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EXAMINER	
LAZORCIK, JASON L	

ART UNIT	PAPER NUMBER
1731	

NOTIFICATION DATE	DELIVERY MODE
05/14/2007	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/521,793	TANI, ELJI	
	Examiner	Art Unit	
	Jason L. Lazorcik	1731	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 February 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-19* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-19* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 3-6, 9, 13, and 16 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Kane (US 3,140,193). The Kane reference teaches a two step reactive coating process for treating a graphite base substrate. Specifically, the reference teaches that "The coating is produced by first coating or reacting the graphite surface with a primary material to form an outer layer of silicon carbide. The outermost graphite remaining at the interface which has not been carburized is then removed leaving a porous outer carbide surface. The outer porous silicon surface is thereafter coated with silicon."

Specifically with respect to Claim 1, Kane teaches producing a suspension comprising finely divided silicon metal in a carrier [**Claim 9, 16**]. This carrier may comprise "Lacquers containing finely divided metals in addition to thickeners, binders and other carbonaceous materials" (Column 6, lines 36-60) which is understood as essentially equivalent to the claimed resin useful as a carbon source (see resin. (n.d.). *Dictionary.com Unabridged (v 1.1)*. Retrieved May 01, 2007, from Dictionary.com website: http://dictionary.reference.com/browse/resin;

"any of a class of nonvolatile, solid or semisolid organic substances, as copal or mastic, that consist of amorphous mixtures of carboxylic acids and are obtained directly from certain plants

as exudations or prepared by polymerization of simple molecules: used in medicine and in the making of varnishes and plastics").

This slurry is coated onto and impregnated into the surface of a graphite substrate or a "porous structural body". The coated slurry coating and graphite substrate are thereafter carbonized by subjecting to an elevated temperature which results in the formation of a solid SiC coating upon the graphite substrate. The reference teaches that "the result is a porous, penetrant layer of SiC, or more correctly a mixture of SiC and graphite, extending in from the surfaces...It is believed that the molten silicon intrudes into the "caves" and "tunnels" of the graphite, and in so doing forms a sinuous and interlocking network of SiC." (Column 5, lines 3-44)

Kane continues by teaching that residual carbon interpenetrating with the formed SiC layer is removed by "reactive sintering" at 1375°C to leave a porous interconnected SiC structure (Column 5, lines 45-67) or a "carbonized porous structural body". After reactive sintering, a second coating of silicon is applied to permeate the "honeycomb structure" (Column 2, Lines 30-42) [**Claim 3,6,13**] and the reference indicates that "As in the initial coating step, the molten silicon metal wets all surfaces of the piece completely."(Column 5, line 69 to Column 6, line 15).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and

> the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 7,8,11,14,15, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kane (US 3,140,193) in view of Luhleich (US 4,293,512). With reference to the content of the silicon powder suspension utilized in the disclosed process, Kane explicitly teaches that "Lacquers containing finely divided metals in addition to thickeners, binders and other carbonaceous materials" (Column 6, lines 36-60) may be employed. Luhleich is however silent regarding the specific details of which carbonaceous binder or "resin" should be utilized or the nature of additional thickeners and/or finely divided metals. To this end, Luhleich teaches teaches a method of providing a protective carbide layer on a graphitic molded article. The reference continues that such a layer is produced by application of a layer comprising suspended silicon powder in a phenolformaldehyde resin or "phenol resoin" [**Claim 7,11, 14,18**] and containing "an additive" or graphitic powder [**Claim 8,11, 15,18**] added to the slurry (Column 2, Lines 47-59). Given the analogous nature of the Kane and Luhelich disclosures, it would have been a merely obvious extension to utilize the Luhelich graphitic powder containing phenolic resin as a component of the Kane slurry

composition. Although Kane does not particularly point to these components by name, Kane does teach their use in general (e.g. thickeners, binders, and other carbonaceous materials ... generally known in the graphite coating arts) and Luhelich provides a reasonable expectation of success in their use.

Claims 10, 12, 17, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kane (US 3,140,193) and Luhleich (US 4,293,512) as applied in the respective claims above and in further view of Johnson (US 4,904,424). While Kane teaches the use of finely divided metals in the slurry composition, neither Kane nor Luhelich teach that a mixture of powdered silicon and one of the indicated elements including aluminum should be utilized in the slurry. Johnson teaches that "silicon forms a eutectic with aluminum" and that by combining aluminum with silicon, the hard to react silicon is activates and reacts more readily (e.g. at a lower temperature) during the formation of silicon carbide (Column 4, Lines 44-59). It would therefore have been obvious to one of ordinary skill in the art at the time of the invention add an amount of aluminum to the silicon powder in the slurry as taught in the Kane disclosure. Since Johnson teaches that alloys of aluminum and silicon melt and form carbide ceramics at lower temperatures than pure silicon, this modification would have been obvious to anyone seeking to save equipment and operating costs by lowering the temperature of the reactive sintering step in the Kane process.

Claim 1, 4, 5, 7-9, and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Luhleich (US 4,293,512).

Luhleich teaches a method of providing a protective carbide layer on a graphitic molded article and that such a layer is produced (abstract) either by:

1. Dipping the molded graphite article into melted silicon,
2. Dipping the molded graphite article into a succession of suspensions or "a slurry" of carbon, silicon, and a binder resin, where each successive layer contains a greater silicon content than the prior layer, ***or***
3. Applying successive layers of a paste of carbon, silicon, and a binder resin, again with each successive layer contains a greater silicon content than the prior layer.

The immediate reference teaches (Column1, Lines 18-24) that the molded graphite article consists of carbonaceous particles in the form of graphite, artificial graphite including carbon black (Column 1, Line34), or the like coated with a binder. This molded graphite article is understood to be functionally equivalent to the claimed "a carbon powder-made porous structural body having a bone structure". It is here noted that while the immediate reference teaches that "there is considerable variety among the known methods of making molded articles of graphite" (Column 1, Lines 25-27), it fails to explicitly indicate that the molded graphite article is formed by extrusion of powdered carbon into a honeycomb shape.

Luhleich further teaches:

1. The slurry or "the resin" comprises suspended silicon powder in a phenolformaldehyde resin which is commonly understood to be "a phenol resin" (see http://en.wikipedia.org/wiki/Phenolic_resin) and containing "an additive" or graphitic powder added to the slurry (Column 2, Lines 47-59).
2. After dipping the molded graphitic body into the slurry or equivalently "applying a slurry...by impregnation" as claimed, the temperature of body is raised to between 1550°C and 1800°C to form silicon carbide. The temperature ramp, conducted under a protective atmosphere of argon or "an inert gas atmosphere", is understood to read upon both the process carbonizing the slurry at 900 to 1,300°C as well as the reaction sintering step at a temperature of 1,300°C or more.

Luhleich teaches that due to the mismatch in thermal expansion coefficients, a layer of SiC formed directly upon carbonaceous material (e.g. a graphite molded body) displays poor adhesive properties and "often breaks off upon cooling after being heated up and the vessel accordingly has only a short useful life for its intended purpose" (Column 2, lines 18-34). Further, the sequential layering approach described above enhances the adhesion of the coating and provides an article with "a long useful life even under high stress".

Regarding Claims 4, 5, 7-9, and 11, The Luhleich reference teaches that a SiC layer is formed on a graphite body either by the sequential layering technique ***or*** by an immersion in molten silicon bath. It fails to explicitly set forth a scenario wherein after the sequential layering and sintering of the slurry on the graphite body, the layered and

sintered body is immersed in a molten silicon bath. Luhleich further teaches that in the absence of the sequential layering technique the adhesion of the SiC layer to the graphite body is poor, and said layering enhances this adhesion and thus the lifetime of the coated part. It would have been obvious to one of ordinary skill in the art at the time of the invention when forming a SiC layer by immersion of a graphite body in molten silicon as taught by Luhleich to ***first*** undertake the sequential layering and sintering process according the above layering technique. This would have been an obvious modification to one of ordinary skill seeking to enhance the adhesion between the SiC layer formed by the immersion process and the molded graphite body as taught by the Luhleich process.

Claims 1 is rejected under 35 U.S.C. 103(a) as obvious over prior art. In the instant case, Claim 1 is drawn to a silicon carbide-based heat resistance porous structural material made the process set forth for the method for manufacturing said material as outlined in Claim 4. As such, Claims amounts to a product-by-process claim for the processes set forth in Claims 4 and 5, respectively.

In the event any differences can be shown for the product-by-process claims 1 and 2, as opposed to the product taught by prior art, such differences would have been obvious to one of ordinary skill in the art as routine modification of the product in the absence of a showing of unexpected results, see In re Thorpe, 227 USPQ 964 (CAFC 1985). As the afore mentioned claim is a product by process claim, it is deemed that "[A]ny difference imparted by the product by process claims would have been obvious to one having ordinary skill in the art at the time the invention was made because where

the examiner has found a substantially similar product as in the applied prior art the burden of proof is shifted to the applicants to establish that their product is patentably distinct, ..."In re Brown, 173 USPQ 685, and In re Fessmann, 180 USPQ 324. Further, "[P]rocess limitations are significant only to the extent that they distinguish the claimed product over the prior art product." In re Luck, 177 USPQ 523 (1973).

Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Luhleich (US 4,293,512) as applied to claims 1, and in further view of Bookbinder (US 5,389,325).

The Luhleich teaches (Column1, Lines 18-24) that the molded graphite article consists of carbonaceous particles in the form of graphite, artificial graphite including carbon black (Column 1, Line34), or the like coated with a binder. While the immediate reference teaches that "there is considerable variety among the known methods of making molded articles of graphite" (Column 1, Lines 25-27), it fails to explicitly indicate that the molded graphite article is formed by extrusion of powdered carbon into a honeycomb shape. Bookbinder teaches the preparation of a slurry of activated carbon and phenolic resin (abstract) and the subsequent formation of the slurry by extrusion (Column 6, lines 65-67) into a honeycomb structure (Column 6, lines 43-45) in order to manufacture a component for engine exhaust purification.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the extruded, honeycomb-shaped graphite engine exhaust part taught by Bookbinder by forming a protective silicon carbide outer skin on said part according to the Luhleich process. This would have been an obvious modification to

anyone seeking to increase the resistance of the part to the effect of corrosive environments at elevated temperatures (Column 1, Lines 14-17) while insuring good interlayer adhesion between the graphite and SiC layers.

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Luhleich (US 4,293,512) as applied to claims 4, and in further view of Bookbinder (US 5,389,325). As indicated in the rejections of claims 3/1 and 3/2 above, it is well known to form honeycomb shaped parts by the extrusion of a graphite powder according to the teachings of Bookbinder. It is also appreciated widely appreciated in the art that silicon carbide coatings enhance the thermal and corrosion resistance of graphite article. Finally, the sequential layering and sintering of a silicon and carbon slurry as outlined in the rejection of Claim 3 above provides enhanced adhesion and thus an extended lifetime for the SiC coated graphite article. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the extruded, honeycomb-shaped graphite engine exhaust part taught by Bookbinder by forming a protective silicon carbide outer skin on said part according to the Luhleich process.

Claims 10 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Luhleich (US 4,293,512) as respectively applied in the rejections of Claim 4 and Claim 5 above and in further view of Johnson (US 4,904,424). Luhleich fails to teach that a mixture of powdered silicon and one of the indicated elements including aluminum should be utilized in the slurry. Johnson teaches that "9aluminum forms a eutectic with aluminum" and that by combining aluminum with silicon, the hard to react silicon is activates and reacts more readily (e.g. at a lower temperature) during the

formation of silicon carbide (Column 4, Lines 44-59). It would therefore have been obvious to one of ordinary skill in the art at the time of the invention add an amount of aluminum to the silicon powder in the slurry as taught in the Luhleich disclosure. Since Johnson teaches that alloys of aluminum and silicon melt and form carbide ceramics at lower temperatures than pure silicon, this modification would have been obvious to anyone seeking to save equipment and operating costs by lowering the temperature of the reactive sintering step in the Luhleich process.

Response to Arguments

Applicant's arguments filed February 15, 2007 have been fully considered but they are not persuasive. Applicant argues that Luhleich "contrasts" the method utilized in the instant reference Example 1 and Example 2 with the conventional molten silicon dipping method. From this assertion, Applicant concludes that the methods from said examples are "clearly not considered to be combinable". Examiner disagrees.

Although the Luhelich reference may set forth preferred embodiments in the cited Examples 1 and 2 which do not explicitly require a subsequent step of immersion in molten silicon, no evidence has been found to substantiate Applicants position wherein said subsequent immersion step is specifically or necessarily excluded. Rather, as set forth in the prior office action dated October 25, 2006, such a process would have been obvious to one of ordinary skill. Specifically, it would have been obvious to utilize a the Luhelich disclosed slurry layer on a graphite substrate as a means to enhance the adhesion of a SiC layer subsequently deposited by the conventional molten silicon

immersion step. Further, Applicant has provided evidence why such a combination of steps would not have been a merely obvious extention over the prior art of record.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason L. Lazorcik whose telephone number is (571) 272-2217. The examiner can normally be reached on Monday through Friday 8:30 am to 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven Griffin can be reached on (571) 272-1189. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JLL.

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